






BMP #15 - Pipe Slope Drain

Targeted Pollutants

-  Sediment
-  Phosphorus
-  Trace metals
-  Bacteria
-  Petroleum hydrocarbons

Physical Limits

Drainage area 5 ac

Max slope 50%

Min bedrock depth 2 ft

Min water table 5 ft

SCS soil type ABCD

Freeze/Thaw good

Drainage/Flood control yes

DESCRIPTION

A pipe slope drain is a device used to carry concentrated runoff from the top to the bottom of a slope that has already been damaged by erosion or is at high risk for erosion. It may be used to convey runoff from offsite around a disturbed portion of the site. It may also be used to drain saturated slopes that have the potential for soil slides. Pipe slope drains can be either temporary or permanent, depending on the method of installation and the material used.

Pipe slope drains are made of flexible tubing or rigid pipe with a prefabricated entrance section. Other temporary slope drains may use plastic sheeting, stone gutters, fiber mats, riprap, concrete or asphalt ditches, or half-round pipe. Outlet protection such as riprap must be provided for velocity dissipation at the drain outlet.

APPLICATIONS

Pipe slope drains are used whenever it is necessary to convey water down a slope without causing erosion. They are especially effective before a slope has been stabilized or before permanent drainage structures are ready for use. Pipe slope drains may be used with other devices, including sediment traps (BMP #27), and vegetative buffer strips (BMP #26).

Temporary pipe slope drains, usually flexible tubing or conduit, may be installed prior to the construction of permanent drainage structures. Permanent slope drains may be placed on or beneath the ground surface; pipes, sectional downdrains, paved chutes, or

clay tiles may be used.

Pipe slope drains are appropriate in the following general locations:

- On cut or fill slopes before permanent storm water drainage structures have been installed.
- Where earth dikes or other diversion measures have been used to concentrate flows.
- On any slope where concentrated runoff crossing the face of the slope may cause gullies, channel erosion, or saturation of slide-prone soils.
- As an outlet for a natural drainageway.

The drainage area may be up to 10 acres (4 hectares).

LIMITATIONS

Not suitable for drainage areas greater than 10 acres (4 hectares).

DESIGN PARAMETERS

Pipe sizing: Typical relationships between area and pipe diameter are shown below:

RELATIONSHIP BETWEEN AREA AND PIPE DIAMETER	
Maximum Drainage Area acres (hectares)	Pipe Diameter in (millimeters)
0.5 acres (0.2)	12 in (300)
1.5 acres (0.6)	18 in (450)
2.5 acres (1.0)	21 in (525)
3.5 acres (1.4)	24 in (600)
5.0 acres (2.0)	30 in (750)

Spacing: For a two-lane highway construction project, experience has shown that temporary slope drains should be spaced at a longitudinal interval of 500 ft (150 meters) on a 2 percent grade, 200 ft (60 meters) on a 4 percent grade, and as may be dictated by field conditions on a grade of 5 percent or greater.

Materials: Pipe may be any heavy-duty, flexible tubing designed for this purpose, including nonperforated, corrugated plastic pipe; corrugated metal pipe; bituminous fiber pipe; or specially designed flexible tubing.

A standard flared end section secured with a watertight fitting should be used for the inlet. A standard T-section fitting may also be used. Extension collars should be 1 ft (300 mm) long segments of corrugated pipe. All fittings must be watertight.

Slope of drain: Try for a 3 percent minimum.

CONSTRUCTION GUIDELINES

Temporary slope drains should be installed with inlets at points where water is discharged from ditches, berms, or other points of concentrated flow. All drains should be anchored to the slope to prevent disruption by water or other forces. The inlet section of the drain should be properly installed to funnel the flow into the drain. It is often necessary to construct cross berms to direct flow into the inlet.

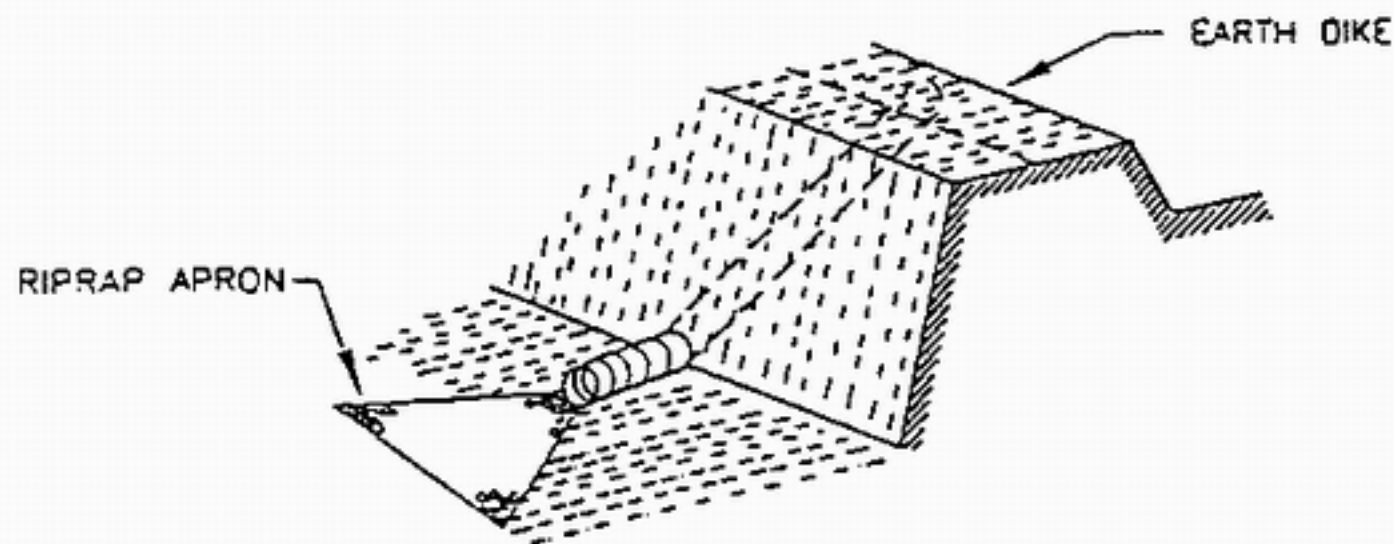
- Place the pipe slope drain on undisturbed or well-compacted soil.

- Soil around and under the entrance section must be hand tamped in 4 to 8 in (100- to 200-mm) lifts to the top of the dike to prevent piping failure around the inlet.
- Place filter cloth under the inlet, extend it 3 to 5 ft (1 to 2 meters) in front of the inlet, and key it in 6 in (150 mm) on all sides to prevent erosion. A 6 in (150-mm) metal toe plate may also be used for this purpose.
- Securely stake the pipe slope drain to the slope at intervals of 10 ft (3 meters) or less, using grommets provided for this purpose.
- Make sure that all slope drain sections are securely fastened together and have watertight fittings.
- Extend the pipe beyond the toe of the slope and discharge at a nonerosive velocity into a stabilized area or to a sedimentation trap or pond. Use rock outlet protection if necessary.
- The pipe slope drain should have a slope of 3 percent or steeper.
- The height at the centerline of the earth dike should range from a minimum of 1 ft (300 mm) over the pipe to twice the diameter of the pipe measured from the invert of the pipe. It should also be at least 6 in (150 mm) higher than the adjoining ridge on either side.
- At no point along the dike will the elevation of the top of the dike be less than 6 in (150 mm) higher than the top of the pipe.
- Immediately stabilize all areas disturbed by installation or removal of the pipe slope drain.

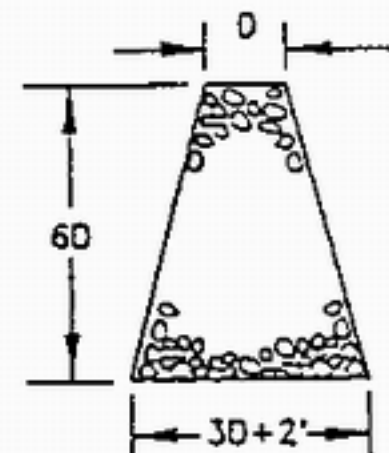
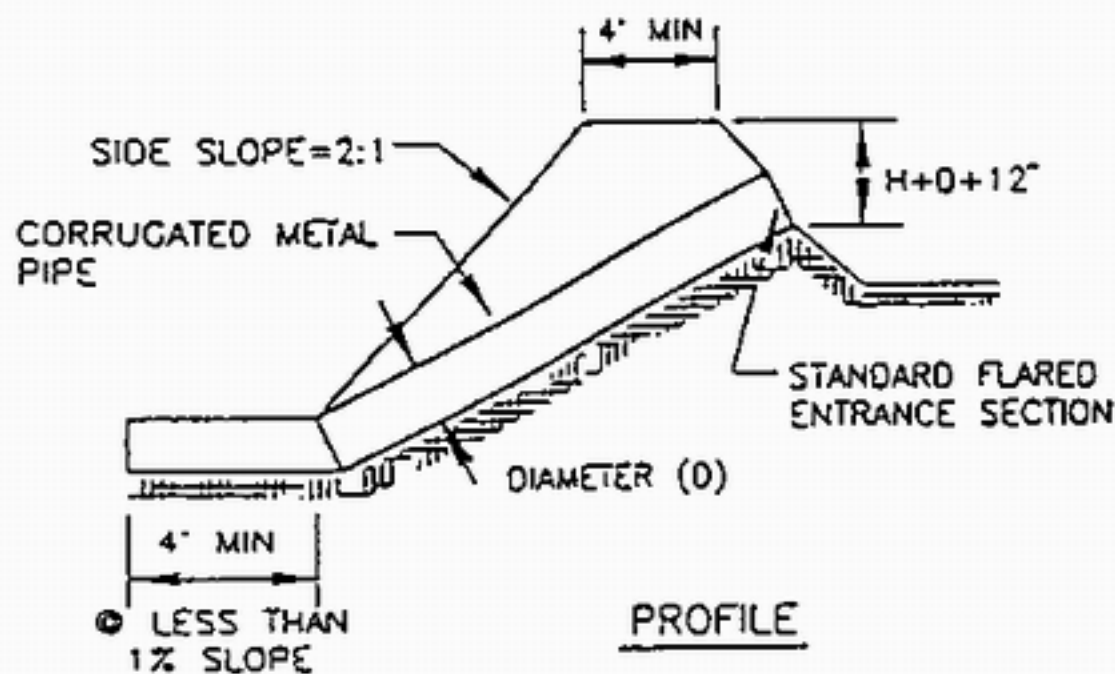
MAINTENANCE

- Inspect the slope drain regularly and after every storm. Make any necessary repairs within 7 days or before the next storm (whichever comes first).
- Check to see that water is not bypassing the inlet or undercutting the inlet or pipe. If necessary, install headwalls or sandbags to prevent bypass flow.
- Check for erosion at the outlet point and check the pipe for breaks or clogs. Install additional outlet protection if needed and immediately repair the breaks and clean any clogs.
- Do not allow construction traffic to cross the pipe slope drain and do not place any material on it.
- If a sediment trap has been provided, clean it out when the sediment level reaches one-third to one-half the design volume.
- A temporary slope drain should remain in place up to 30 days after slopes have been completely stabilized.

PIPE SLOPE DRAIN (RIGID)



GSS-2
PSD-DIAM
STANDARD SYMBOL



RIPRAP SHALL CONSIST OF 6" DIAMETER STONE PLACED AS SHOWN AND SHALL BE A MINIMUM OF 12" IN THICKNESS.

RIPRAP APRON PLAN

NOTE. SIZE DESIGNATION IS: PSD-PIPE DIAMETER
(ie. PSD-12 = PIPE SLOPE DRAIN WITH 12" DIAMETER PIPE)

CONSTRUCTION SPECIFICATIONS

- 1 THE PIPE SLOPE DRAIN SHALL HAVE A SLOPE OF 3% OR STEEPER.
- 2 TOP OF THE EARTH DIKE OVER THE INLET PIPE AND ALL DIKES CARRYING WATER TO THE PIPE SHALL BE AT LEAST ONE FOOT HIGHER THAN THE TOP OF THE PIPE.
- 3 ADD 0.3 FOOT TO DIKE HEIGHT FOR SETTLEMENT.
- 4 SOIL AROUND AND UNDER THE SLOPE PIPE SHALL BE HAND TAMPED IN 4 INCH LIFTS.
- 5 THE PIPE SHALL BE CORRUGATED METAL PIPE WITH WATERTIGHT 12 INCH CONNECTING BANDS OR FLANGE CONNECTIONS.
- 6 RIPRAP TO BE 4-8 INCHES IN A LAYER AT LEAST 8 INCHES IN THICKNESS AND PRESSED INTO THE SOIL.
- 7 PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

MAXIMUM DRAINAGE AREA: 5 ACRES

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GRADE STABILIZATION
STRUCTURE

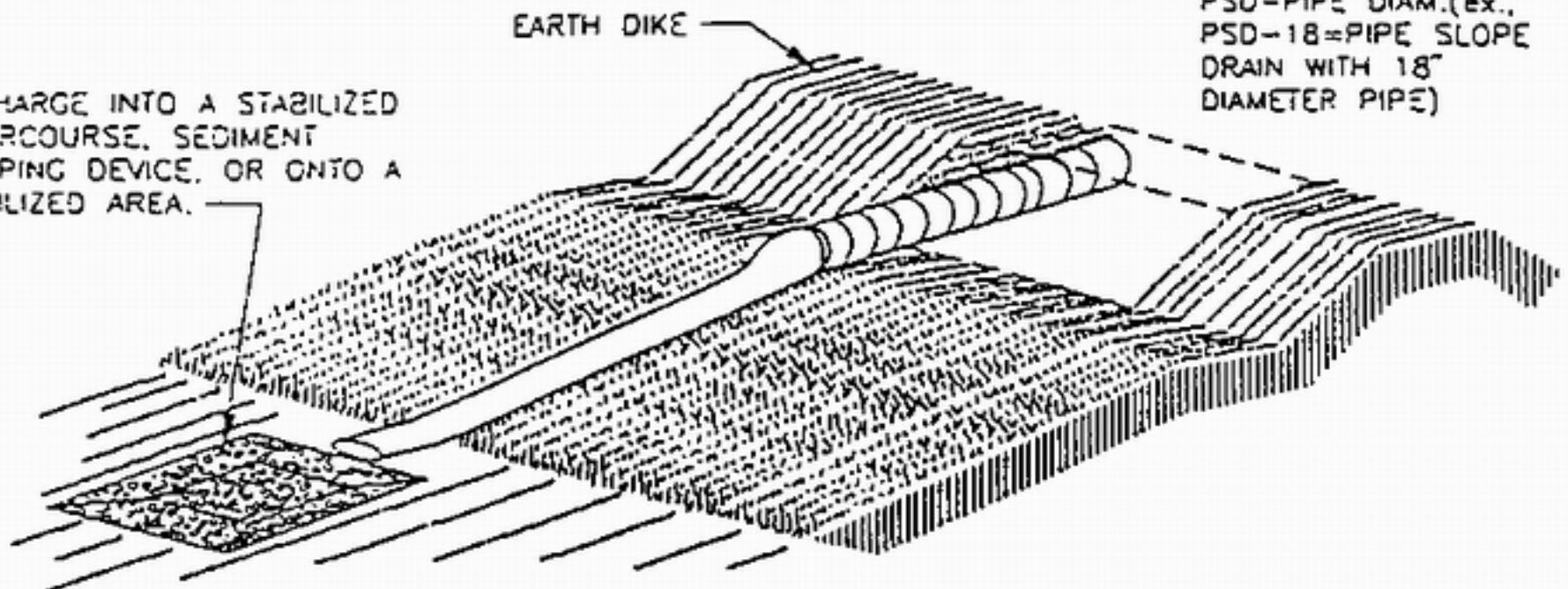
STANDARD
DRAWING

GSS-2

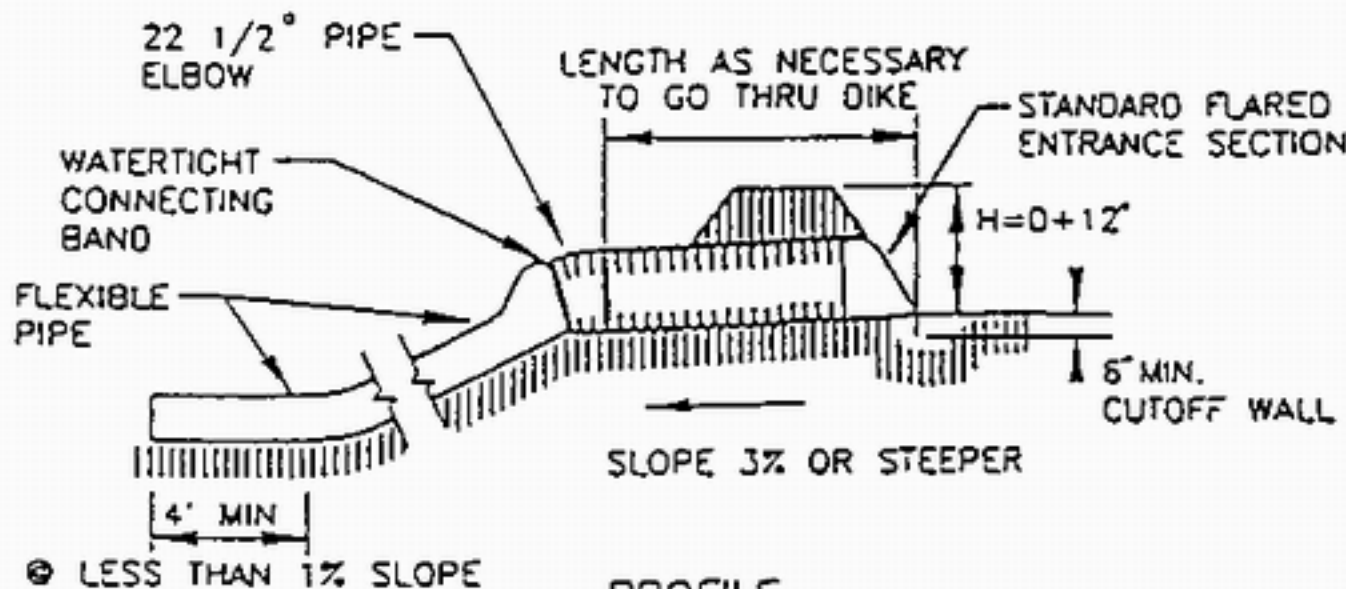
PIPE SLOPE DRAIN (FLEXIBLE)*

NOTE. SIZE DESIGNATION IS:
PSD-PIPE DIAM.(ex.,
PSD-18=PIPE SLOPE
DRAIN WITH 18"
DIAMETER PIPE)

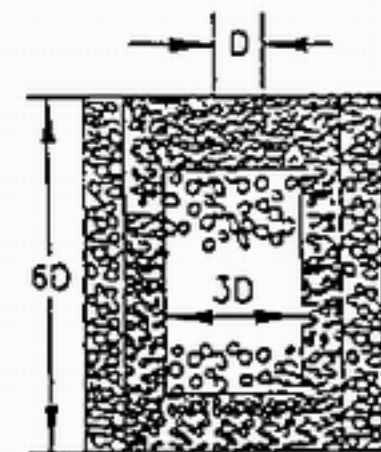
DISCHARGE INTO A STABILIZED
WATERCOURSE, SEDIMENT
TRAPPING DEVICE, OR ONTO A
STABILIZED AREA.



PERSPECTIVE VIEW



PROFILE



RIPRAP SHALL CONSIST OF 6" DIAMETER STONE PLACED AS SHOWN. DEPTH OF APRON SHALL EQUAL THE PIPE DIAMETER AND RIPRAP SHALL BE A MINIMUM OF 12" IN THICKNESS.

RIPRAP APRON PLAN

CONSTRUCTION SPECIFICATIONS

- 1 THE INLET PIPE SHALL HAVE A SLOPE OF 3% OR STEEPER.
- 2 THE TOP OF THE EARTH DIKE OVER THE INLET PIPE AND THOSE DIKES CARRYING WATER TO THE PIPE SHALL BE AT LEAST 1' HIGHER AT ALL POINTS THAN THE TOP OF THE INLET PIPE.
- 3 THE INLET PIPE SHALL BE CORRUGATED METAL PIPE WITH WATERTIGHT CONNECTING BANDS.
- 4 THE FLEXIBLE TUBING SHALL BE THE SAME DIAMETER AS THE INLET PIPE AND SHALL BE CONSTRUCTED OF A DURABLE MATERIAL WITH HOLD-DOWN GROMMETS SPACED 10' ON CENTERS.
- 5 THE FLEXIBLE TUBING SHALL BE SECURELY FASTENED TO THE CORRUGATED METAL PIPE WITH METAL STRAPPING OR WATERTIGHT CONNECTING COLLARS.
- 6 THE FLEXIBLE TUBING SHALL BE SECURELY ANCHORED TO THE SLOPE BY STAKING AT THE GROMMETS PROVIDED.
- 7 A RIPRAP APRON SHALL BE PROVIDED AT THE OUTLET. THIS SHALL CONSIST OF 6" DIAMETER STONE PLACED AS SHOWN ON THE ABOVE DRAWING.
- 8 THE SOIL AROUND AND UNDER THE INLET PIPE AND ENTRANCE SECTION SHALL BE HAND TAMPED IN 4" LIFTS TO THE TOP OF THE EARTH DIKE.
- 9 FOLLOW-UP INSPECTION AND ANY NEEDED MAINTENANCE SHALL BE PERFORMED AFTER EACH RAIN EVENT.

* DRAINAGE AREA MUST NOT EXCEED 5 ACRES.

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GRADE STABILIZATION
STRUCTURE

STANDARD
DRAWING

GSS-3